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Scottish Bowel Screening Programme colonoscopy quality – scope for improvement?

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Abstract

Aim The delivery of the Scottish Bowel Screening Programme (SBoSP) is rooted in the provision of a high quality, effective and participant-centred service. Safe and effective colonoscopy forms an integral part of the process. Additional accreditation as part of a multi-faceted programme for participating colonoscopists, as in England, does not exist in Scotland. This study aimed to describe the quality of colonoscopy in the SBoSP and compare this to the English national screening standards.

Methods Data were collected from the SBoSP between 2007 and 2014. End-points for analysis were caecal intubation, cancer, polyp and adenoma detection, and complications. Overall results were compared with 2012 published English national standards for screening and outcomes from 2006 to 2009.

Results During the study period 53 332 participants attended for colonoscopy. The colonoscopy completion rate was 95.6% overall. The mean cancer detection rate was 7.1%, the polyp detection rate was 45.7% and the adenoma detection rate was 35.5%. The overall complication rate was 0.47%.

Conclusion Colonoscopy quality in the SBoSP has exceeded the standard set for screening colonoscopy in England, despite not adopting a multi-faceted programme for screening colonoscopy. However, the overall adenoma detection rate in Scotland was 9.1% lower than that in England which has implications for colonoscopy quality and may have an impact on cancer prevention rates, a key aim of the SBoSP.

Keywords Screening colonoscopy, performance

What does this paper add to the literature?
Our results demonstrate that, although high standards of colonoscopy can be delivered within a national screening programme without the multi-faceted approach adopted by the National Health Service Bowel Cancer Screening Programme, the adenoma detection rate within the Scottish Bowel Screening Programme is 9.1% less than the National Health Service Bowel Cancer Screening Programme. This is the first study to demonstrate this finding and has important implications for the delivery of screening colonoscopy.

Introduction

Population-based colorectal cancer (CRC) screening using tests for the presence of occult blood in faeces leads to a reduction in disease-specific mortality [1–3]. The primary aim of CRC screening is to reduce mortality by early detection and treatment of cancer. A secondary aim is to detect and remove adenomas in order to prevent progression of these to cancer. The provision of high quality colonoscopy within a screening programme is fundamental to achieving these aims and has been emphasized in recent studies and guidelines [4,5].

The adenoma detection rate (ADR) is a widely used indicator of colonoscopy quality; it is a marker of both the technical quality of the procedure and the efficacy of the screening strategy [6,7]. ADR is known to vary widely both between and within screening programmes [8–11]. Much of this variation may be explained by factors relating to the quality of the colonoscopy

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performed. In a study of 300 000 screening, surveillance or diagnostic colonoscopies, performed by 136 colonoscopists, the ADR was inversely associated with the risks of interval CRC, advanced-stage interval cancer and fatal interval cancer [12].

A UK audit of colonoscopy published in 2004 raised concerns about the quality of colonoscopy in the UK, showing caecal intubation in only 76.9% of 9223 procedures and an overall perforation rate of 1:769 [13]. In consequence, measures have been introduced in the UK over the last decade to improve the quality of colonoscopy. These include a national endoscopy training programme, defined parameters for endoscopy training coordinated by the Joint Advisory Group (JAG) on Gastrointestinal Endoscopy and national endoscopy standards (defined by the Global Rating Score) [14]. In England, endoscopists wishing to perform colonoscopy and centres wishing to participate in the National Health Service Bowel Cancer Screening Programme (NHS BCSP) must undergo additional accreditation to ensure that investigation is undertaken by a competent colonoscopist with appropriate facilities and quality assurance. However, this process of approving colonoscopists with a competency test was deemed inappropriate in Scotland because of concerns about introducing a two-tier colonoscopy service and, in consequence, no such approval process exists. This study aimed to assess whether, despite this, screening colonoscopy quality in the Scottish Bowel Screening Programme (SBoSP) is comparable to the English national standards and published results from the NHS BCSP.

Method

All men and women aged between 50 and 74 years and registered with a general practitioner were invited to participate in the SBoSP. The SBoSP methodology has been described previously [15] and is summarized here. Each potential participant was then sent a pre-invitation letter and guaiac faecal occult blood test (gFOBT) kit (hema-screen, Immunostics Inc., Ocean, New Jersey, USA, supplied by Alpha Laboratories Ltd, Eastleigh, Hants, UK). Following any positive test result, individuals were pre-assessed, either face-to-face or through telephone consultation, by a bowel screening specialist endoscopy nurse and then referred for colonoscopy if this was deemed appropriate. Bowel preparation was performed in accordance with local guidelines, which may vary between the hospital sites in Scotland at which screening and other colonoscopies are performed.

In Scotland, screening colonoscopy was carried out by colonoscopists selected by the 14 individual NHS Boards responsible for delivery of healthcare. Clinical standards developed by the SBoSP required that any procedure should be performed by a colonoscopist who had demonstrated at least 90% completion in continuous audit and had undergone a JAG approved course in basic skills in colonoscopy. However, specific individual accreditation was not mandated – unlike in England [16] where all screening colonoscopists are accredited by means of a minimum number of lifetime procedures, adequate performance data evident with continuous audit, a knowledge test and a direct observation of the performance of two procedures by two trained assessors using a structured and validated competency framework (DOPS, direct observation of procedural skills). In addition, unlike with the BCSP, in Scotland screening procedures are not necessarily performed on dedicated screening lists and will depend on individual unit policy. As such, results are self-reported.

The study population and associated dataset were assembled by the Information Services Division of NHS National Services Scotland. Data were extracted from the Scottish Bowel Screening IT System. Colonoscopy completion was defined as successful caecal intubation on an intention to treat basis. Failed examinations owing to, for example, obstructing lesions or poor bowel preparation were counted as incomplete. Cancer, polyp or adenoma detection was defined as the number of participants examined who were found to have cancer or polyps or adenomas respectively. Mean adenoma per procedure was defined as the number of adenomas detected divided by the total number of procedures. Adverse events were defined as those that prevented completion of the planned procedure (excluding technical failure or poor bowel preparation) or resulted in admission to hospital, prolongation of existing hospital stay, another interventional procedure or subsequent medical consultation [16]. Adverse events were recorded and validated by individual trusts. Results were published and fed back to screening centres at trust level. Missed cancers were defined as those diagnosed in patients with a positive screening test and negative colonoscopy within a defined follow-up period, which was 2 years or the time between screening test result and next round invitation, whichever occurs first.

To allow comparison with the NHS BCSP, which commences screening at 60 years, a sub-group analysis was performed for the 60–74-year-old population.

Statistical analysis

Continuous variables are presented as the mean (range). Categorical variables are presented as a proportion (%). Associations between categorical variables were examined using χ^2 tests for linear trend unless otherwise specified. A P value of <0.05 was considered statistically

significant. Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, Illinois, USA).

Results

From 2007 to 2014 inclusive, data from 5 308 336 invitations to participate in the SBoSP were available for analysis: 2 954 199 (55.7%) successfully completed the screening test and 68 140 (3.0%) gave positive screening test results. 53 332 participants (78.3%) who had positive screening test results attended for colonoscopy. 31 102 participants (56.5%) attending colonoscopy were men. The trend of examinations performed per year is shown in Fig. 1. A total of 3777 cancers were detected at colonoscopy with a positive predictive value of colonoscopy (after a positive FOBT) for cancer of 7.1%. Polyps and adenomas were detected in 24 345 and 18 934 colonoscopies respectively.

Colonoscopy quality indicators

Colonoscopy completion rates were 95.6% overall, 96.9% in men and 93.7% in women. Caecal intubation rates (CIR) deteriorated as the SBoSP was rolled out nationally with the greatest deterioration observed in women. CIR then gradually improved in both men and women to a completion rate of 96.6% overall (Fig. 2).

The mean cancer detection rate (CDR) was 7.1%, 7.8% in men and 6.1% in women. The 60–74 year age sub-group had an overall CDR of 8.4%, 9.3% in men and 7.2% in women. The CDR dropped during the first 4 years of the SBoSP before reaching a plateau as cancers were 'screened out' of the population, representing the overall shift from prevalence to incidence screening (Fig. 3).

Figure 2 Colonoscopy completion rates per year in men and women as caecal intubation (%).

The mean polyp detection rate (PDR) was 45.7%, 52.0% in men and 36.8% in women. The 60–74 year sub-group had an overall PDR of 47.0%, 53.0% in men and 39.0% in women. The PDR increased during the first 2 years of roll-out before reaching a plateau (Fig. 4).

The mean ADR was 35.5%, 41.3% in men and 27.3% in women (Table 1). Within the 60–74-year-old age sub-group specifically, the ADR was 37.4% overall, 42.8% for men and 29.7% for women. The ADR since national roll-out has remained consistent (Fig. 5). Similar to the situation observed with CIR during national roll-out, the ADR reduced as additional hospitals and endoscopists participated. This trend was observed in both men and women. The mean number of adenomas detected in those who had adenomas at colonoscopy was 2.11.

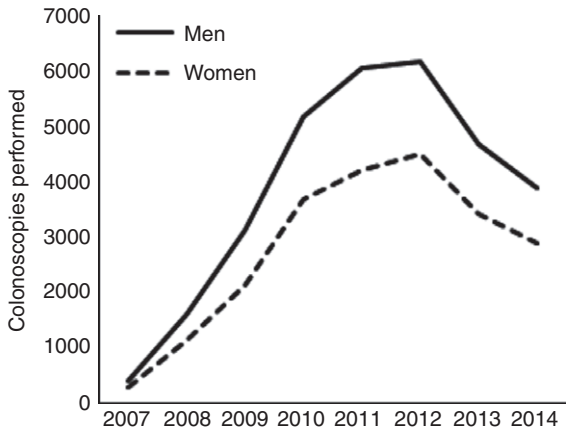

Figure 1 Number of colonoscopies performed per year in men and women in the Scottish Bowel Screening Programme.

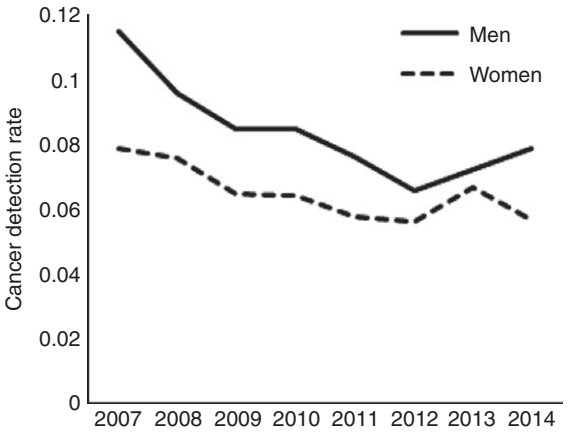

Figure 3 Trends of cancer detection rates in men and women in the Scottish Bowel Screening Programme.

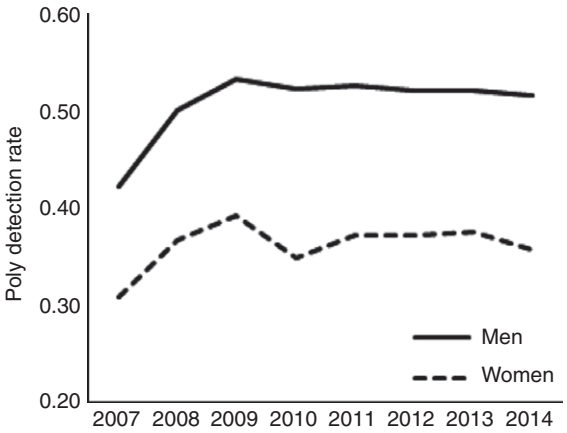

Figure 4 Trends of polyp detection rates in men and women in the Scottish Bowel Screening Programme.

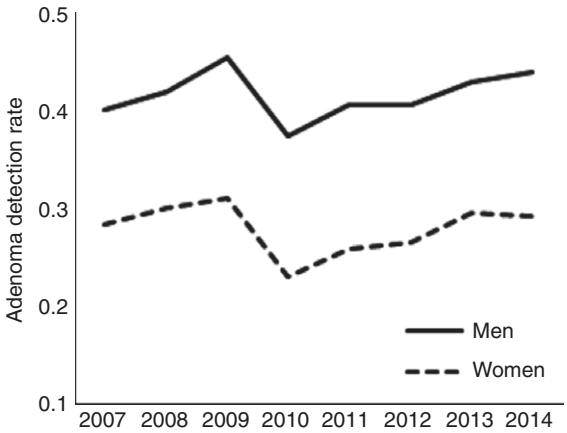

Figure 5 Trends of adenoma detection rates in men and women in the Scottish Bowel Screening Programme.

There were 269 complications overall (0.47%). Overall perforation rate was 0.08%. There were 11 pneumatic perforations, 14 mechanical perforations and 20 therapeutic perforations. Post-colonoscopy bleeding requiring admission occurred in 213 participants (0.37%). There were 11 sedation-related complications (0.02%). There was one colonoscopy-related mortality.

Data for missed cancers are available for 2007–2009. There were 12 cases of missed cancer within this group (0.17).

A comparison between the main outcomes in the SBoCP (2007–2014) and the NHS BCSP (2006–2009) is given in Table 2. The outstanding difference is the ADR: 37.4% in Scotland (60–74 year age group) and 46.5% in England. Unpublished data from the BCSP to 2014 have shown a continuous improvement in adjusted ADR to 47.4%. Comparable study period BSCP data for complication rates and missed cancer rates are not available.

Discussion

This study demonstrates high-quality colonoscopy in the SBoSP. The data show that colonoscopy can be delivered to a high standard, thus ensuring screening participant safety. The results compare very favourably with the 2004 English national audit in which the unadjusted CIR was 76.9% [13] and are similar to the 2011 national audit (95.6% *vs* 92.3%) [17] and 2012 NHS BCSP reported quality measures (95.6% *vs* 95.2%) [7].

Colonoscopy in general needs to strike a balance between risks and benefits. Within the context of any bowel screening programme, this balance is exaggerated, because asymptomatic participants, not patients with symptoms, are placed in harm's way. The procedure is invasive, with the potential for causing serious and significant adverse events [18]. Colonoscopy performance has been found in the past to be variable, as demonstrated by a national audit that demonstrated poor completion rates and higher than expected perforation rates [13]. Strategies to attain and maintain minimum standards through quality assurance frameworks were introduced in England to ensure equity of provision and access to consistent reproducible standards for screening participants throughout the NHS BCSP, aiming to minimize the risks and maximize the benefits of screening. This quality assurance framework is supported through the JAG accreditation of endoscopy units and through rigorous accreditation for

Table 1 Colonoscopy key performance indicators.

	n	Complete (%)	Cancer	CDR	CDR (60–74 years)	Polyp	PDR	PDR (60–74 years)*	Adenoma	ADR	ADR (60–74 years)
Men	31 102	30 143 (96.9)	3011	0.10	0.09	16 174	0.52	0.53	12 865	0.41	0.43
Women	22 230	20 824 (93.7)	1639	0.07	0.07	8171	0.37	0.39	6069	0.27	0.27
Total	53 332	50 967 (95.6)	4650	0.09	0.08	24 345	0.46	0.47	18 934	0.36	0.37

CDR, cancer detection rate; PDR, polyp detection rate; ADR, adenoma detection rate.
*Sub-group analysis of participants aged 60–74 years.

Table 2 Scottish Bowel Screening Programme (SBoSP) quality indicators for the 60–74-year-old sub-group compared with the English NHS Bowel Cancer Screening Programme (BCSP) reported results, quality assurance guidelines and target standards.

	Guidelines (%)	Target (%)	SBoSP (%)	NHS BCSP (%) [7]	*P*
Caecal intubation	90	>97	95.2	95.2	ns
Cancer detection		11	8.0	10.6	<0.001
Adenoma detection	35	40	37.4	46.5	<0.001
Perforation	<0.1		0.08	0.09	ns
Polypectomy perforation	<0.5		0.08		
Bleeding	<1.0		0.37		

colonoscopists participating in the NHS BCSP. Failure by an accredited BCSP colonoscopist to reach agreed standards, or to provide the required data returns, may result in a series of sanctions [16].

The SBoSP CDR was lower than that advocated in the quality assurance guidelines [16]. However, Scottish results are comparable to those published from the first million invitations in England [19]. In addition, the publication on colonoscopy quality measures within the NHS BCSP argued against, and omitted, the CDR as a quality measure. The data on trends of cancer detection as part of a national programme demonstrate lower CDR in subsequent incident rounds compared with the prevalent round [20], consistent with other bowel screening programmes [20,21]. As such, the CDR represents a poor marker of screening colonoscopy quality and reflects cancer incidence more [11,22].

Polyp detection rates are independently a poor indicator of colonoscopy performance and are omitted from many programmes as a quality indicator. As such comparing the PDR of different programmes is difficult due to inconsistent reporting. However, with careful audit or PDR to ADR ratio, it is recognized that the PDR can be used as a surrogate for ADR [23].

However, the most widely used metric for assessing colonoscopy quality is the ADR. Our study showed a mean ADR of 35.5%, reflecting the above average risk of detecting adenomas in people with a positive screening test result in the target age group. The lower ADR in Scotland compared with England (35.6% *vs* 46.5%) is not a result of the lower age of the beginning of invitations to screen compared with England (50 *vs* 60 years). The ADR reported here is similar to the pilot evaluation of bowel cancer screening in the UK which had an inclusion age range of 50–70 years [11,22]. However, when a subgroup analysis is performed during a similar time period when prevalence screening would be similar to participants aged 60–74 years, the unadjusted ADR in Scotland remains 9.1% lower than that achieved in England.

Unpublished data provided by the BCSP have demonstrated that, within the BSCP, the adjusted ADR has continued to increase and was 47.4% in 2014. While this could be explained by regional differences in adenoma prevalence, this seems unlikely given the overall higher levels of deprivation and higher incidence of CRC in Scotland than in England [24]. This difference is clinically significant given the known association between ADR and interval cancer rate. In a US study which analysed post-colonoscopy cancer development rates for individual endoscopists, a 1% increase in ADR was associated with a 3% reduction in subsequent cancer development rates. Whilst this calculation cannot be applied to any bowel cancer screening programme, it does highlight the importance of improving standards and increasing the ADR. The reasons may be multi-factorial and require further investigation. However, the design and set-up of the two programmes must be a contributing factor. Different to the SBoSP, with the BCSP there was selection (commissioning) of both screening centres and screening colonoscopists, using accreditation as the criterion. These processes were intended (a) to give the programme the best chance of success from the outset and (b) to continually drive up standards once the programme started. A number of factors unique to the BCSP encourage continuous quality improvement. Patients in the BCSP have their procedure done on a dedicated list, adjusted for the case mix, giving extra time to perform a screening colonoscopy, with a maximum of four cases per list. There is also a regular review of screening centres by BCSP and JAG quality assurance teams and continuous feedback of ADR and other quality parameters to screening centres and individuals. In addition within the BCSP there are defined processes for mentoring screeners and dealing with poor performance with further training or, if standards are still not met, retirement from the programme. Even the threat of being reviewed is likely to have an effect. Of course it is not possible to say which of these

processes had the greatest impact but evidence indicates that high quality and continuous improvement is more likely when several things are done simultaneously and may explain the reason why there has been no change in ADR over time within the SBoSP [25].

The adverse event rates in this study are similar to other published series, which typically report post-colonoscopy bleeding in 0.03%–0.22% of procedures and perforation in 0.01%–0.80% of procedures. Accepting that 35.5% of procedures require at least one polypectomy and many involve removal of large and multiple polyps, the low level of adverse events is pleasing and compares favourably to those of the 2004 (0.50%) [13] and 2011 audits [17]. However, it must be noted that a direct comparison with the BCSP is flawed due to the different methodologies of reporting.

The complete collection and quality of the data is a major strength of this study. Quality of collected data is itself a marker of quality of a screening programme and feedback on data quality issues raised through this study will improve the future quality of the data collection process. An important additional strength of this study is its size, both in terms of the number of colonoscopies analysed and the nationwide coverage of the SBoSP. These data show that a high level of colonoscopy quality can be achieved in a large screening programme. Nevertheless, our study has several limitations. FOBT-based national screening programmes are now uncommon across the world so that comparison of colonoscopy quality with other countries is difficult. In addition, data for individual colonoscopists, sedation practices and patient comfort satisfaction scores are not collected routinely. It is widely accepted that the reporting of sedation practice provides a surrogate marker for technical quality, participant safety and participant experience and reflects overall colonoscopy quality as part of a screening programme [16,26].

The results presented here demonstrate that colonoscopic quality in the SBoSP is acceptable according to the standards set by the NHS BCSP quality assurance guidelines in England. The Scottish programme without accreditation delivers a high quality screening process with quality markers exceeding those set initially in other programmes. However, the published data from the English programme do demonstrate higher ADRs. The accreditation process may be one of many important factors in this. In consequence, our study therefore vindicates the decision by the English NHS BSCP to adopt a multi-faceted approach to ensuring high quality colonoscopy, a component of which is the accreditation test for screening colonoscopists. It also highlights the potential for improvement of colonoscopy quality within the SBoSP and supports measures to drive forward standards within the programme.

Conflicts of interest

The authors have no financial declarations.

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Commentary: Accrediting colonoscopy services and colonoscopists for screening makes a difference

The report from Quyn *et al.* [1] in this issue describes the performance of the Scottish Bowel Cancer Screening Programme and makes comparisons with the English Bowel Cancer Screening Programme (BCSP). The processes of invitation and selection for colonoscopy in the two programmes are identical, but with different age ranges. However, there are differences in the preparation, delivery and monitoring of colonoscopy services to investigate screen detected positives. A comparison of colonoscopy performance enables inferences as to whether different approaches are significant.

The main finding is of a substantial difference (9%) in the adenoma detection rates (ADR) in the 60–74 age cohorts. There was no statistical test of difference but the sample size is large and the difference is likely to be statistically significant. Are the differences clinically significant? Three studies have shown that low ADR is associated with higher rates of interval cancer [2–4]. In one of these, it was estimated that for every 1% increase in ADR there is a 3% reduction in risk of colorectal cancer [3]. This estimate was based on a study of colonoscopy in an average risk screening population in the west coast of America and may not be applicable in the UK setting. However, most colonoscopists would consider a 9% difference in ADR to be clinically important. The available literature suggests that we shall see higher rates of post colonoscopy colorectal cancer [5] in patients who have had a colonoscopy in the Scottish programme.

How did this difference arise and what lessons can we learn? Given a similar ethnic mix and higher levels of social deprivation, smoking and drinking in the Scottish population compared to England, it seems improbable that lower ADR was due to biological or lifestyle differences in the screened populations. Perhaps, the most likely explanation is the different approach preparing, delivering and monitoring colonoscopy services.

The key differences in approach are in England: designated, JAG accredited [6], colonoscopy screening centres; screening colonoscopists who undergo a summative test of competence [7]; and dedicated lists for screening colonoscopy with a maximum of four patients on a list. Furthermore, in England all screening centres and colonoscopists receive individual level colonoscopy performance data regularly and there was a defined process to identify and support poor performers [8]. The Scottish programme did not do any of these things, or at least not to the same degree.